CLAIMS

We claim:

1. A composition, comprising:
a nanoparticle comprising a rare earth element doped in a metal oxide, wherein the surface of said nanoparticle is functionalized with a biological molecule or a polyionic polymer, and wherein said nanoparticle is capable of light emission.

2. A composition, comprising:
a silica glass nanoparticle comprising a first metal oxide and optionally a second metal oxide, wherein the surface of said nanoparticle is functionalized with a biological material or a polyionic polymer, and wherein said nanoparticle is capable of light emission.

3. The composition of claim 2, wherein said first metal oxide or said second metal oxide is a rare earth oxide.

4. A composition, comprising:
a magnetic nanoparticle core and a shell comprising a first metal oxide and optionally a second metal oxide, wherein said nanoparticle is capable of light emission.

5. The composition of claim 4, wherein said first metal oxide or said second metal oxide is a rare earth oxide.

6. The composition of claim 4, wherein the surface of said nanoparticle is functionalized with a biological material or a polyionic polymer.

7. The composition of any of claims 1, 2, and 6, wherein said biological molecule or polyionic polymer is selected from the group consisting of a protein, a peptide, a nucleic acid, a lipid, a poly-lysine, and a carbohydrate.

8. The composition of claim 7, wherein said protein is selected from the group consisting of an antibody, an antibody fragment, an scFv, and a receptor.

9. The composition of any one of claims 1-8, wherein said nanoparticle is capable of fluorescent light emission.

10. The composition of any one of claims 1-8, wherein said nanoparticle is capable of phosphorescent light emission.

11. The composition of any of claims 1-8, wherein the diameter of said nanoparticle is between 10 nm and 1000 nm.

12. The composition of claim 11, wherein the diameter of said nanoparticle is between 10 nm and 200 nm.

13. The composition of claim 12, wherein the diameter of said nanoparticle is between 10 nm and 100 nm.

14. The composition of claim 13, wherein the diameter of said nanoparticle is between 20 nm and 50 nm.

15. The composition of claims 3 or claim 5, wherein said rare earth is a lanthanide.

16. The composition of claim 15, wherein said lanthanide is selected from the group consisting of Eu, Er, Ce, Nd, Sm, Tb, Dy, Gd, Ho, Tm, and combinations thereof.

17. The composition of any of claims 1-8, wherein said first or said second metal oxide is selected from the group consisting of Cr_2O_3, Y_2O_3, ZrO_2, ZnO, CuO, Cu_2 O, Gd_2O_3, Pr_2O_3, La_2O_3, Fe_2O_3, and Fe_3O_4.

18. An improved assay for detecting the presence of an analyte in a sample, said assay comprising contacting a sample suspected of containing said analyte with a labeled composition under conditions in which said analyte specifically binds said labeled composition, and detecting the presence of said label, the improvement comprising: using the composition of any of claims 7-14 as said labeled composition.

19. The assay of claim 18, wherein said assay is a direct assay.

20. The assay of claim 18, wherein said assay is a competition assay.

21. A method for synthesizing a nanoparticle capable of light emission, comprising:
providing a rare earth compound, optionally a metal and optionally a silicon compound;
vaporizing said provided compound or compounds;
thermally oxidizing or decomposing said vaporized compounds in a reaction zone at a temperature sufficient to cause said vaporized compounds to thermally oxidize or decompose; and
condensing said oxidized or decomposed vaporized compounds thereby forming nanoparticles capable of light emission.

22. The method of claim 21, wherein said rare earth compound is a lanthanide nitrate.

23. The method of claim 21, wherein said rare earth compound is $Eu(TMHD)_3$.

24. The method of claim 21, wherein said silicon compound is HMDS.

25. The method of claim 21, wherein said metal is selected from the group consisting of Na, Zn, Zr, Cu, Gd, Pr, Fe, and La.

26. The method of claim 21, wherein said vaporizing step comprises heating said provided compound or compounds to generate a vapor or vapors;
and said thermally oxidizing or decomposing step comprises entraining said vapor or vapors in a combusting gas stream.

27. The method of claim 19, wherein said vaporizing step comprises generating a spray from a solution of said provided compound or compounds;
and said thermally oxidizing or decomposing step comprises entraining said spray in a combusting gas stream.

28. The method of claim 27, wherein said solution of provided compound or compounds comprises a colloidal solution of a nanoparticle and a lanthanide nitrate.

29. A method of functionalizing with a biological material or a polyionic polymer a nanoparticle capable of light emission, comprising:
incubating said nanoparticle capable of light emission in an aqueous solution of said biological material or polyionic polymer under conditions in which said biological materials adsorb to the surface of said nanoparticles.

30. The method of claim 29, wherein said biological material or polyionic polymer is selected from the group consisting of a protein, a peptide, a nucleic acid, a poly-lysine, and a carbohydrate.

31. The method of claim 30, wherein said protein is selected from the group consisting of an antibody, an antibody fragment, an scFv, and a receptor.

32. The method of claim 30, wherein said biological material is a protein, a peptide, and said method further comprises reacting a second molecule with a functional group provided by said protein or said peptide.

33. The method of claim 29, wherein said aqueous solution of said biological materials is a mixture of biological materials, comprising a non-specific blocking biological material and a biological material that provides a specific binding site.

34. A method of functionalizing a nanoparticle capable of light emission, comprising: collecting in a gas stream nanoparticles synthesized according to the method of any of claims 21-27, and mixing said gas in a mixing chamber with a silane vapor and optionally a water vapor.

35. An apparatus substantially as shown in any of Figures 1-3.